

The Most Economical Use of Biogas? It's Not Always CHP.

Producing renewable natural gas provides economic, environmental and resiliency advantages for the Western Virginia Water Authority

by **Steve Lund**
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Workers spread concrete for a new digester at the Roanoke Regional Water Pollution Control Plant.

Putting biogas to work has been a priority at the Roanoke Regional Water Pollution Control Plant since it was built in 1951.

Back then, biogas from the plant's anaerobic digesters powered pumps to move raw sewage.

"You have to give our predecessors credit for having a beneficial use all those years ago," says Scott Shirley, chief operating officer for water quality with the Western Virginia Water Authority. "Since the inception of the plant, we've been on a journey to maximize the beneficial use of biogas."

Over the years, the plant staff found other uses for the biogas, such as boiler fuel to heat the digesters and for a combined heat and power system. Recently, the plant began converting biogas to renewable natural gas fed into the utility network.

The new plan generates Renewable Identification Numbers, which are worth money under the U.S. EPA's Renewable Fuel Standards Program. "With the economics of this as well as the benefit to the environment and to the community, we believe it's the highest beneficial use of the gas," Shirley says.

Multiple factors

Several factors beyond economics influenced the decision to produce RNG. One was a maintenance issue with the combined heat and power system: The emission controls on the system didn't react well to the variable BTU content of the biogas.

"Basically, if the system senses a drop in BTU value, it tries to enhance the burn, and it causes damage to the engines," Shirley says. "A lot of plants experience similar challenges."

One potential solution was to blend the biogas with natural gas to make a more stable fuel, but the authority decided to take another route. "Options have been developed to improve the reliability of cogeneration systems," Shirley says, "But in our case, concurrently with this we did a major upgrade of the plant electrical system to improve reliability."

"The cogen units will be reinstated to run just off natural gas, and they'll be part of a suite of generators available as a backup system. If we lose utility power, we have a 2 MW Cummins diesel backup generator, a diesel-powered 1,700 hp Roots blower, and then the two 500 kW Waukesha cogen units. Between those, we can supply power into our own grid and run for an extended period if we lose power."

The authority has experienced flooding in the past and has made substantial investments in flood protection. Says Shirley, "We now have one foot of freeboard from a 100-year flood. Part of that investment extends to the electrical system."

"If we had stayed on the previous distribution system, the two substations that could feed the plant were subjected to the same flood risk. In this larger power project, we connected to a transmission line that gets us to a second substation geographically separated from that risk."

Boosting gas production

The Roanoke Regional Water Pollution Control Plant (55 mgd design, 37 mgd average) is an advanced facility with seven primary anaerobic digesters and three secondary digesters. As part of its RNG conversion, the plant team fitted five of the digesters with new Ovivo linear-motion mixers and with concrete covers cast in place.

Refinement to RNG includes pretreatment (Unison Solutions) to remove hydrogen sulfide, moisture, siloxanes and VOCs, plus compression to pipeline pressure and membrane separation to remove CO₂. An interconnect station odorizes, meters and monitors gas delivered to the Roanoke Gas pipeline. Gas production from the digesters with the new mixers has more than met expectations.

"It looks like we're going to get about 308,000 cubic feet per day," Shirley says. "That would generate 2,200 RINs per day, and the current RIN value is in excess of \$3." At that price, the project would pay for itself in about five years.

If the price falls to the historical normal level, payback would take about 10 years. After Roanoke Gas and the authority recover their costs, they will split the revenue from the RINs.

Changing marketplace

Shirley says the market for renewable energy credits tilts toward producing RNG instead of burning raw biogas at the plant. RNG also has environmental benefits. "In the environmental analysis, we're displacing natural gas that generally would be derived through fracking," Shirley says. "When that is replaced by RNG, we believe that's substantially better for the total environmental picture."

The authority may add digestion of high-strength food waste, but U.S. EPA rules require separate monitoring of gas created that way and through digestion of biosolids: the latter is more valuable. The authority might eventually dedicate some digesters now offline to handling food waste.

"They're in reserve for a later project to consider whether it's worthwhile for us to look at a high-strength waste receiving program," Shirley says.

The RNG conversion involved a major electrical upgrade, backup power and flood protection along with gas treatment. "We take the approach that it's important to harden our assets and really plan well for emergencies," Shirley says.

"The engineers we work with tell me that I like belts and suspenders. Yes I do. I've been around 29 years and I've been through enough disasters and challenges. I want all options."



The Roanoke Regional Water Pollution Control Plant treats an average of 37 mgd.



Digesters were upgraded and new mixers added when the Western Virginia Water Authority began converting its biogas to renewable natural gas.



Membrane filters are part of the Unison Solutions system to convert biogas to renewable natural gas.